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$$\therefore x = \frac{100 + .\frac{5}{3}(1.03^{10} - 1)}{1.03^{10}} = \$117.0604.$$

For (b),  $a=100$ ,  $n=10$ ,  $R=.05$ ,  $r=.03$ ,  $r'=.04$ .

$$\therefore x = \frac{100 + .\frac{5}{4}(1.04^{10} - 1)}{1.03^{10}} = \$119.0777.$$

If in (a) interest were payable semi-annually, we should have  $a=100$ ,  $n=20$ ,  $R=.025$ ,  $r=.015$ ,  $r'=.015$ , and  $x=\$117.168+$ , or  $\$117.17$  as given in the tables of bond values used by brokers and bankers.

Also solved by *E. W. MORRELL*, *B. F. YANCEY* and *G. B. M. ZERR*. Prof. Morrell obtained as results  $\$118.356$  and  $\$117.661$ ; and Proposer, to last part,  $\$117.60$ .

57. Proposed by *J. C. CORBIN*, Pine Bluff, Arkansas.

Find the quotient of

$$\left| \begin{array}{cccc} (s-a_1)^2 & a_1^2 & a_1^2 & \dots & a_1^2 \\ a_2^2 (s-a_2)^2 & a_2^2 & a_2^2 & \dots & a_2^2 \\ a_3^2 & a_3^2 & (s-a_3)^2 & \dots & a_3^2 \\ \dots & \dots & \dots & \dots & \dots \\ a_n^2 & a_n^2 & a_n^2 & \dots & s-a_n^2 \end{array} \right| \div \left| \begin{array}{cccc} s-a_1 & a_1 & a_1 & \dots & a_1 \\ a_2 & s-a_2 & a_2 & \dots & a_2 \\ a_3 & a_3 & s-a_3 & \dots & a_3 \\ \dots & \dots & \dots & \dots & \dots \\ a_n & a_n & a_n & \dots & s-a_n \end{array} \right|$$

Solution by *G. B. M. ZERR*, *A. M.*, Ph. D., Professor of Mathematics and Applied Science in Texarkana College, Texarkana, Arkansas-Texas.

Let  $Q$ =the quotient and as we can exchange row for column without altering the value, we get

$$Q = \left| \begin{array}{cccc} (s-a_1)^2 & a_2^2 & a_3^2 & \dots & a_n^2 \\ a_1^2 (s-a_2)^2 & a_3^2 & a_3^2 & \dots & a_n^2 \\ a_1^2 & a_2^2 (s-a_3)^2 & a_3^2 & \dots & a_n^2 \\ \dots & \dots & \dots & \dots & \dots \\ a_1^2 & a_2^2 & a_3^2 & \dots & (s-a_n)^2 \end{array} \right| \div \left| \begin{array}{cccc} s-a_1 & a_2 & a_3 & \dots & a_n \\ a_1 & s-a_2 & a_3 & \dots & a_n \\ a_1 & a_2 & s-a_3 & \dots & a_n \\ \dots & \dots & \dots & \dots & \dots \\ a_1 & a_2 & a_3 & \dots & s-a_n \end{array} \right|$$

All the elements in the  $i^{th}$  column of the numerator being  $a_i^2$ , of the denominator  $a_i$ , except in the  $i^{th}$  row which is  $(s-a_i)^2$  for numerator, and  $s-a_i$  for denominator. Hence, we have

$$Q = \left| \begin{array}{cccc} 1, & 0, & 0, & 0, & \dots \\ 1, & (s-a_1)^2, & a_2^2, & a_3^2, & \dots \\ 1, & a_1^2, & (s-a_2)^2, & a_3^2, & \dots \\ 1, & a_1^2, & a_2^2, & (s-a_3)^2, & \dots \\ \dots & \dots & \dots & \dots & \dots \end{array} \right| \div \left| \begin{array}{cccc} 1, & 0, & 0, & 0, & \dots \\ 1, & s-a_1, & a_2, & a_3, & \dots \\ 1, & a_1, & s-a_2, & a_3, & \dots \\ 1, & a_1, & a_2, & s-a_3, & \dots \\ \dots & \dots & \dots & \dots & \dots \end{array} \right|$$

Multiply first column of numerator by  $a_i^2$ , of the denominator by  $a_i$  and subtract from the  $i^{th}$  column; do this for each column and the value is unaltered.

$$\therefore Q = \begin{vmatrix} 1, & -a_1^2, & -a_2^2, & -a_3^2, & \dots \\ 1, & s(s-2a_1), & 0, & 0, & \dots \\ 1, & 0, & s(s-2a_2), & 0, & \dots \\ 1, & 0, & 0, & s(s-2a_3), & \dots \\ \dots & \dots & \dots & \dots & \dots \end{vmatrix} \div \begin{vmatrix} 1, & -a_1, & -a_2, & -a_3, & \dots \\ 1, & s-2a_1, & 0, & 0, & \dots \\ 1, & 0, & s-2a_2, & 0, & \dots \\ 1, & 0, & 0, & s-2a_3, & \dots \\ \dots & \dots & \dots & \dots & \dots \end{vmatrix}$$

Let  $u = (s-2a_1)(s-2a_2)(s-2a_3)\dots(s-2a_n)$ .

$$\sum \frac{a_i^2}{s-2a_i} = \frac{a_1^2}{s-2a_1} + \frac{a_2^2}{s-2a_2} + \frac{a_3^2}{s-2a_3} + \dots$$

$$\therefore Q = \frac{s^{n-1} u \left\{ s + \sum \frac{a_i^2}{s-2a_i} \right\}}{u \left\{ 1 + \sum \frac{a_i}{s-2a_i} \right\}} = \frac{s^{n-1} \left\{ s + \sum \frac{a_i^2}{s-2a_i} \right\}}{\left\{ 1 + \sum \frac{a_i}{s-2a_i} \right\}}.$$

ERRATA. On page 52 of last issue, line 3 from bottom, read = before  $\frac{1}{c}$ , and in the denominator read  $\sqrt{a^2-x^2}$  for " $\sqrt{a^2+x^2}$ "; on page 53, line 15, extend the radical sign over  $a^2-x^2$  and  $b^2-x^2$ , in the numerators.

## PROBLEMS.

64. Proposed by A. H. BELL, Box 184, Hillsboro, Illinois.

Solve the equations:

$$a^2x = (2x^2 - a^2)\sqrt{x^2 + y^2} \dots (1).$$

$$b^2y = (2y^2 - b^2)\sqrt{x^2 + y^2} \dots (2).$$

65. Proposed by COOPER D. SCHMITT, A. M., Professor of Mathematics, University of Tennessee, Knoxville, Tennessee.

Prove that  $\cos \frac{n\pi}{7} + \cos \frac{3n\pi}{7} + \cos \frac{5n\pi}{7} = \frac{1}{2}$  or  $-\frac{1}{2}$ , according as  $n$  is odd

or even.